	Type	L #	Hits	Search Text
1	BRS	L1	557	diversity and (delay with switch)
2	BRS	L2	52	diversity same (delay with switch)
3	BRS	L3	119	combiner same (delay near3 variable)

	DBs	Time Stamp	Comments	Error Definition
1	USPAT; US-PGPUB	2004/04/15 13:46		
2	USPAT; US-PGPUB	2004/04/15 14:40		
3	USPAT; US-PGPUB	2004/04/15 14:41		

	Type	L #	Hits	Search Text
1	BRS	L1	233	455/276.1.ccls.
2	BRS	L2	15893	phase near3 compensat$3
3	BRS	L3	26	1 and 2

	DBs	Time Stamp	Comments	Error Definition
1	USPAT; US-PGPUB	2004/04/15 12:38		
2	USPAT; US-PGPUB	2004/04/15 12:39		
3	USPAT; US-PGPUB	2004/04/15 12:39		

US006085104A

United States Patent [19]

Kowalski et al.

[11] Patent Number: 6,085,104

[45] Date of Patent: Jul. 4, 2000

[54] **PILOT AIDED, TIME-VARYING FINITE IMPULSE RESPONSE, ADAPTIVE CHANNEL MATCHING RECEIVING SYSTEM AND METHOD**

[75] Inventors: **John M. Kowalski**; **Srinivas Kandala**, both of Vancouver, Wash.; **V. Srinivasa Somayazulu**, Tigard, Oreg.

[73] Assignee: **Sharp Laboratories of America, Inc.**, Camas, Wash.

[21] Appl. No.: **09/048,240**

[22] Filed: **Mar. 25, 1998**

[51] **Int. Cl.**[7] **H04B 15/00**

[52] **U.S. Cl.** **455/506**; 455/226.3; 370/335

[58] **Field of Search** 455/506, 226.3, 455/307; 375/350, 200, 349, 347; 370/342, 335, 252, 519

[56] **References Cited**

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Article entitled, Fast Cell Search Algorithm in DS-CDMA Mobile Radio Using Long Spreading Codes, by K. Higuchi, M. Sawahashi and F. Adashi, published in IEEE VTC Conference, pp. 1430–1434, May, 1997.

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Document entitled "An Overview of the Application of Code Division Multiple Access (CDMA) to Digital Cellular Systems and Personal Cellular Networks", May 21, 1992, updated and retitled version submitted to TIA TR45.5 Subcommitte on Mar. 28, 1992, pp. 1–57.

Primary Examiner—Dwayne D. Bost

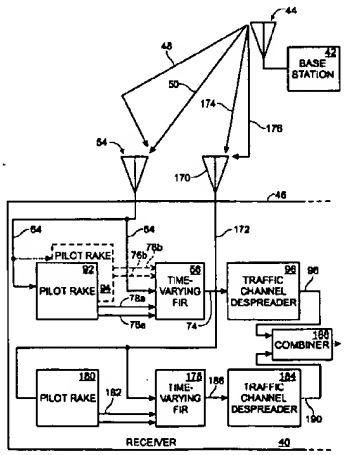
Assistant Examiner—Erika A. Gary

Attorney, Agent, or Firm—David C. Ripma; Matthew D. Rabdau

[57] **ABSTRACT**

A wideband receiver, including a time-varying finite impulse response (FIR) filter, has been provided to combine multipath communications of data in response to pilot channel timing information. The time-varying FIR processes the multipath communications through independent signal paths. Each signal path includes a variable delay circuit and a variable gain circuit. The delay of each separate signal path is adjusted and made equal in response to the pilot channel timing information. Likewise, the gain of each signal path is adjusted in response to pilot channel gain information to maximize the signal to noise ratio of the combined signal paths. The separate signal paths are then summed in a combiner circuit. The time-varying FIR permits the data communication to be summed either before, or after demodulation. A method of combining multipath communications using a time-varying FIR is also provided.

13 Claims, 7 Drawing Sheets



United States Patent [19]

Greenstein et al.

[11] **Patent Number: 4,512,034**

[45] **Date of Patent: Apr. 16, 1985**

[54] **TECHNIQUE FOR DIGITAL RADIO SPACE DIVERSITY COMBINING**

[75] Inventors: **Lawrence J. Greenstein**, Edison; **Yu S. Yeh**, Freehold, both of N.J.

[73] Assignee: **AT&T Bell Laboratories**, Murray Hill, N.J.

[21] Appl. No.: **512,603**

[22] Filed: **Jul. 11, 1983**

[51] **Int. Cl.**[3] **H04B 7/08**

[52] **U.S. Cl.** **455/139**; 455/276; 455/278; 455/304

[58] **Field of Search** 455/52, 65, 137-139, 455/273, 276, 278, 304; 375/100, 102

[56] **References Cited**

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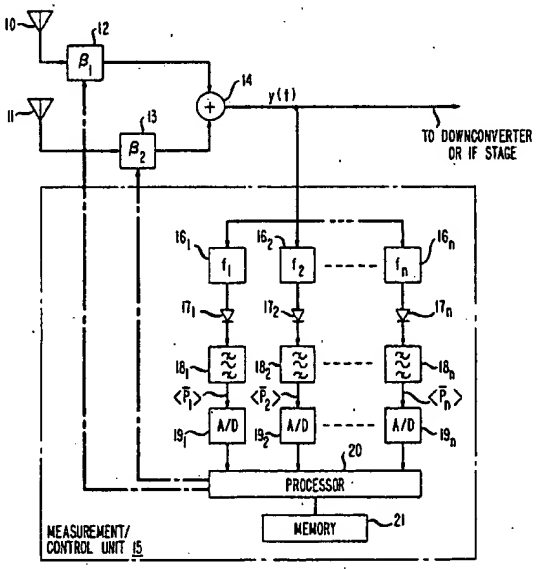
Primary Examiner—Marc E. Bookbinder
Attorney, Agent, or Firm—Erwin W. Pfeifle

[57] **ABSTRACT**

The present invention relates to a space diversity combiner which includes two branches wherein separate multipath signals received from a remote source are propagated. The branch signals are combined and the combiner output signal is used for obtaining noncoherent spectrum measurements which are in turn used to account for both dispersion and noise in controlling the relative amplitudes and phases of the two branch signals to provide a maximum performance measure for the combiner.

5 Claims, 2 Drawing Figures



United States Patent [19]

Easterling et al.

[11] **4,278,978**

[45] **Jul. 14, 1981**

[54] **BASEBAND SIGNAL COMBINER FOR LARGE APERTURE ANTENNA ARRAY**

[76] Inventors: **Robert A. Frosch**, Administrator of the National Aeronautics and Space Administration, with respect to an invention of **Mahlon E. Easterling**, Altadena; **Robin A. Winkelstein**, La Crescenta, both of Calif.

[21] Appl. No.: **76,643**

[22] Filed: **Sep. 18, 1979**

[51] **Int. Cl.**[3] **H04B 7/00**

[52] **U.S. Cl.** ..... **343/100 CL**; 455/278

[58] **Field of Search** ..... 343/100 CL, 100 LE; 455/139, 278

[56] **References Cited**

U.S. PATENT DOCUMENTS

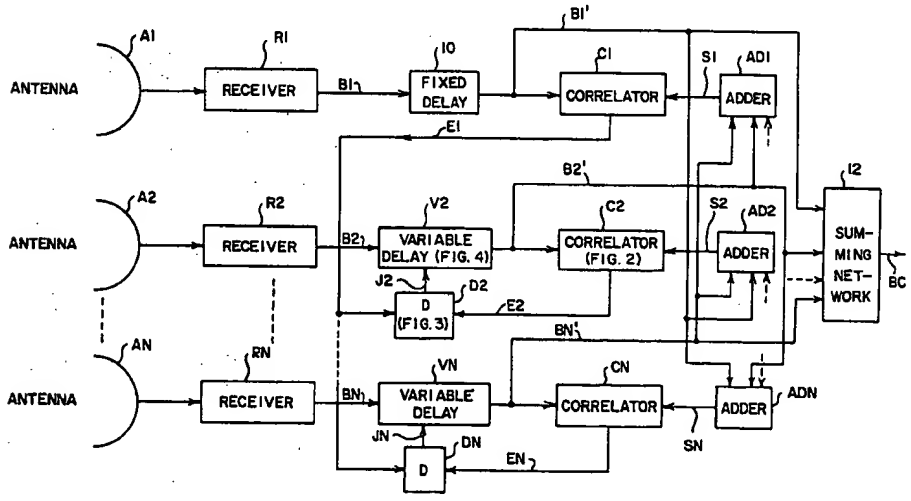
4,005,426 1/1977 Wite ..... 343/100 CL

Primary Examiner—Theodore M. Blum
Attorney, Agent, or Firm—Monte F. Mott; John R. Manning; Paul F. McCaul

[57] **ABSTRACT**

A method and apparatus for combining baseband signals from a large aperture antenna array in which none of the individual baseband signals has a sufficiently high signal-to-noise ratio to be used as a correlation or reference signal for phase adjusting the remaining baseband signals. More specifically, the invention provides a means whereby the baseband output signals of all but one of the receivers associated with each of the antennas are summed and used as a correlation reference for the baseband signal not contained in the summed signal, thereby providing a plurality of correlation or alignment loops, each having an output signal related to the phase difference between its input baseband signal and the summed signal. The invention further provides a means for subtracting an output or error signal generated in one of the correlation loops whose baseband signal has a predetermined phase delay from all the other alignment loops, thereby avoiding interaction and reflection effects in the signal combiner. A variable phase delay means for each of the other baseband signals is controlled by its corresponding correlation loop. The invention discloses how a plurality of loops operating in the above manner provides a means for adjusting the phase of each baseband signal so that they will all be in phase with each other and can thus be added to provide a composite signal output having a higher signal-to-noise ratio than any of the individual baseband signals.

17 Claims, 5 Drawing Figures



US006546236B1

(12) **United States Patent**
Canada et al.

(10) **Patent No.: US 6,546,236 B1**
(45) **Date of Patent: Apr. 8, 2003**

(54) **PHASE-COMPENSATING POLARIZATION DIVERSITY RECEIVER**

(75) Inventors: **Robert O. Canada**, Forest, VA (US); **Walter D. Rawle**, Lynchburg, VA (US)

(73) Assignee: **Ericsson Inc.**, Research Triangle Park, NC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 830 days.

(21) Appl. No.: **08/910,297**

(22) Filed: **Aug. 11, 1997**

(51) **Int. Cl.**[7] **H04B 1/10**

(52) **U.S. Cl.** **455/304**; 455/276.1; 455/506; 455/278.1

(58) **Field of Search** ..... 455/272, 273, 455/276.1, 303, 304, 334, 504, 506, 65, 137, 139, 278.1, 279.1, FOR 110–114; 343/797, 895, 756; 375/347; 333/21 A; 342/362

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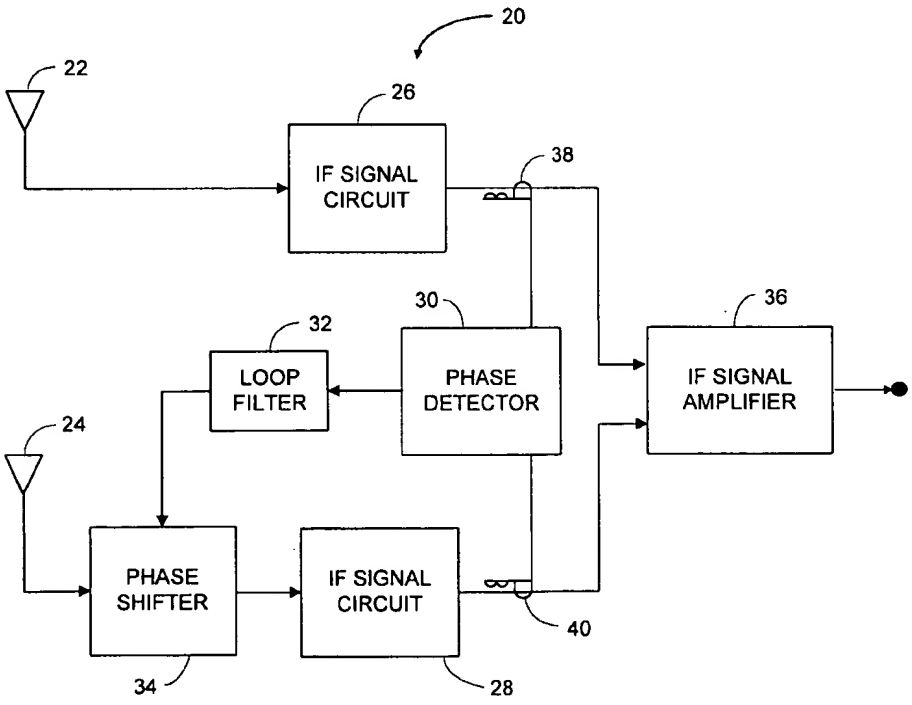
Primary Examiner—Vivian Chin
Assistant Examiner—James K Moore
(74) *Attorney, Agent, or Firm*—Coats & Bennett, P.L.L.C.

(57) **ABSTRACT**

A receiver and an associated method are disclosed for combining signals having substantially different polarizations. The receiver is used with a first antenna which receives first polarized signals and a second antenna which receives second polarized signals, the first polarized signals having a substantially different polarization than the second polarized signals. The receiver includes a phase shifter and a combiner circuit. The phase shifter adjusts the phase of the first polarized signal in response to the phase of the second polarized signal to produce a phase compensated first signal. The combiner circuit sums the second polarized signal and the phase compensated first signal to generate a combined polarization received signal. In this manner, the depolarized signals are phase-aligned with, and then combined with, the polarized signals to provide a strong received signal irrespective of any depolarization of the received signal.

15 Claims, 2 Drawing Sheets



US006256340B1

(12) **United States Patent**
Schilling

(10) **Patent No.: US 6,256,340 B1**
(45) **Date of Patent: *Jul. 3, 2001**

(54) **PHASED ARRAY SPREAD SPECTRUM SYSTEM AND METHOD5**

(75) Inventor: **Donald L. Schilling**, Sands Point, NY (US)

(73) Assignee: **InterDigital Technology Corporation**, Wilmington, DE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/280,328**

(22) Filed: **Mar. 29, 1999**

Related U.S. Application Data

(63) Continuation of application No. 08/859,522, filed on May 20, 1997, now Pat. No. 5,926,502, which is a continuation of application No. 08/625,254, filed on Apr. 1, 1996, now Pat. No. 5,633,889, which is a continuation of application No. 08/266,769, filed on Jun. 28, 1994, now Pat. No. 5,659,572, which is a continuation-in-part of application No. 08/155,173, filed on Nov. 22, 1993, now Pat. No. 5,422,908.

(51) **Int. Cl.**[7] **H04B 1/707**

(52) **U.S. Cl.** **375/148**; 375/150; 375/152; 375/347; 375/348; 455/139; 455/276.1; 342/375; 342/378

(58) **Field of Search** 375/200, 206, 375/349, 347, 148, 150, 152; 342/368, 374, 375, 378; 455/506, 65, 276.1, 139

(56) **References Cited**

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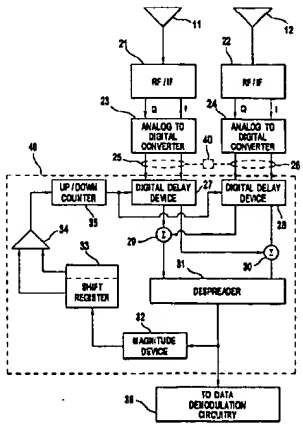
Digital Communications With Space Applications, S.W. Golomb et al., Prentice–Hall, Inc., 1964, pp. 45–64.

Primary Examiner—Amanda T. Le
(74) *Attorney, Agent, or Firm*—Volpe and Koenig, P.C.

(57) **ABSTRACT**

A phased array spread spectrum system for maximizing signal strength of a spread-spectrum signal with multipath through the use of receiving means, delaying means, combining means, despreading means, generating means, storing means and comparing means. The receiving means receives a plurality of spread-spectrum signals and a plurality of phased versions of the plurality of spread-spectrum signals. The delaying means delays the received plurality of spread-spectrum signals with respect to the plurality of phased versions of the plurality of spread-spectrum signals by a plurality of delays. The combining means combines the delayed spread-spectrum signals and the plurality of phased versions of the plurality of spread-spectrum signals as a plurality of combined signals. The despreading means despreads the plurality of combined signals as a plurality of despread signals. The generating means generates a plurality of magnitude values from the plurality of despread signals. The storing means stores a plurality of previous-magnitude values previously generated by the generating means and a plurality of present magnitude values presently generated by the generating means. The comparing means compares the previous-magnitude values and the present-magnitude values and, responsive to the comparison, outputs a plurality of comparison signals. The delaying means responds to the plurality of comparison signals by lengthening or shortening the plurality of delays.

14 Claims, 4 Drawing Sheets



US-PAT-NO: 4373210

DOCUMENT-IDENTIFIER: US 4373210 A

TITLE: Space diversity combiner

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Detailed Description Text - DETX (4):

In operation, the received signals S.sub.1 and S.sub.2 arrive at some arbitrary phase relative to each other. If the two signals are to be combined for maximum power at the receiver, a compensating phase shift must be introduced by phase shifter 13. The amount of phase shift is determined by phase modulating signal S.sub.1 by means of a relatively low frequency sinusoid and sensing the resulting amplitude modulation on the combined signal. The phase controller adjusts the phase shifter so as to minimize the amplitude modulation. (See, for example, U.S. Pat. No. 4,160,952 for a more detailed discussion of phase control in diversity combiners.)

Current US Cross Reference Classification - CCXR (2):

455/276.1

United States Patent [19]

Seastrand, Jr.

[11] **4,160,952**

[45] **Jul. 10, 1979**

[54] **SPACE DIVERSITY RECEIVER WITH COMBINED STEP AND CONTINUOUS PHASE CONTROL**

[75] Inventor: **Kurt L. Seastrand, Jr.**, Andover, Mass.

[73] Assignee: **Bell Telephone Laboratories, Incorporated**, Murray Hill, N.J.

[21] Appl. No.: **905,156**

[22] Filed: **May 12, 1978**

[51] **Int. Cl.**[2] **H04B 7/04**

[52] **U.S. Cl.** **325/369**; 325/476

[58] **Field of Search** ..... 325/369, 31, 41, 56, 325/60, 302, 304, 305, 306, 365, 366, 367, 476; 343/100 AD, 100 CS, 100 CL, 205, 206; 328/155, 133; 324/83 R; 179/15 AN

[56] **References Cited**

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Primary Examiner—Benedict V. Safourek
Assistant Examiner—Tommy F. Chin
Attorney, Agent, or Firm—Sylvan Sherman

[57] **ABSTRACT**

Prior art circuits used in space diversity systems for combining the two received signals employ either continuously variable phase shifters, which have return-to-zero problems, or 90 degree phase steppers which combine the signals to within ±45 degrees. Both of these limitations are avoided by the use of the combination of a continuously variable phase shifter (**14**) and a 90 degree phase stepper (**13**). Control means (**19, 20**) are provided for actuating the stepper when the phase shift introduced by the variable phase shifter reaches a prescribed limit.

5 Claims, 6 Drawing Figures